929,365

PATENT SPECIFICATION

NO DRAWINGS

929,365

Date of Application and filing Complete Specification: July 13, 1961.

No. 25351/61.

Application made in Germany (No. C23044 IV/39b) on Dec. 27, 1960.

Complete Specification Published: June 19, 1963.

Index at acceptance:—Classes 2(6), P4A, P4C(2:5:8C), P4D(3B1:8), P4K(7:11), P4T2A, P7A, P7C(2:5:8C), P7D(1A:8), P7K(4:11), P7T2A, P11A, P11C(2:5:8C), P11D(4:7), P11K(4:7), P11T2A; 95, B4(B:C:X); and 140, A2(F:N3:N4), A5G(7:9), A10B(2:3), A16A, A16B(2:3).

International Classification:—C08d, f. (B05. B29d).

COMPLETE SPECIFICATION

Bonding of Cross-Linked Ethylene Vinyl Acetate Polymerisates to Metallic and other Surfaces

We, CONTINENTAL GUMMI-WERKE AKTIENGESELLSCHAFT, of Continental-Haus, Hanover Germany; a German body corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention concerns the bonding of cross-linked copolymers of ethylene and vinyl acetate to metallic and other surfaces.

Numerous processes have been worked out in the past for bonding natural or synthetic polymers to metallic and other surfaces. A number of processes use an adhesive intermediate layer and others use a suitable metal alloy as adhesion promoting agent. The application of intermediate layers, either in the form of adhesives or in the form of metal alloys, always involves considerable operational expense. Other processes too, which propose an acid pre-treatment of the metallic surfaces, require an additional material and operational expense.

These disadvantages are overcome by the present invention.

It has been found that an excellent bond is obtained when a copolymer of ethylene and vinyl acetate (hereinafter called EVM) is cross-linked using a peroxide cross-linking agent in the presence of a low-molecular organic phosphate having a plurality of olefinic double bonds, and then bonded to the surface of a metal or of a polymeric material by heating.

It has been ascertained that this effect of obtaining a direct bond to metals and polymers is characteristic of the use of a low molecular organic phosphate having a plurality of olefinic double bonds as the cross-linking activator and occurs, for example when triallyl phosphate is used. It is a surprising and novel feature that these compounds have this effect with EVM. It could not have been foreseen because no similar result can be obtained with other polymers, for example natural and synthetic rubber.

The EVM may also be mixed with other elastomers, for example natural or synthetic rubber, and with fillers and thus, as a component of a mixture, may be used to bond elastomers to metals. It is of particular advantage that this direct bonding of an elastomer to a metal is equally applicable to iron and to light metals, for example aluminium.

The invention may also be used to bond EVM to the surface of other polymers, for example of butadienestyrene copolymers, chloroprene, polyvinyl chloride and mixtures thereof.

Thus, by means of the present invention, EVM may be used on the one hand as the component of a mixture to bond elastomers to metals or polymers and on the other hand in effect as an adhesive intermediate layer when building laminates.

In tests carried out using mixtures of EVM with carbon black in the process according to the present invention, bonds to metals have been obtained which withstood forces (measured statically), of more than 40kg/cm^2. When rupture tests were carried out, rupturing was observed to occur always within the elastomer layer and not at the metal elastomer bond.

Bonding also occurs when using bright fillers, alone or in mixture with carbon black. Here it was shown that the strength of adhesion of the bond could be increased by adding natural or synthetic resins, for example rosin or its derivatives and phenol-formaldehyde resins, until statically ascertained adhesion

values of over 80 kg/cm² could be obtained.

The layer of EVM may be applied to the metal for bonding in various ways. It is possible, for example, to apply the elastomer layer to the metal surface by spreading or spraying a solution or steeping a metal body therein. On the other hand, an EVM-containing composition in solid form may be brought into contact with the metal surface. The bond may be formed by heating in a mould.

It is also possible according to the present invention to carry out the cross-linking and the bonding simultaneously by incorporating in the un-cross-linked polymer a peroxide, for example dicumyl peroxide, and the organic phosphate having the double bonds, for example triallyl phosphate, and simultaneously bonding the copolymer to the surface at a temperature between 100° and 160°C. It is thus possible to produce this bond on apparatus conventionally used in the rubber industry under conditions generally prevailing for rubber processing.

The advantage of the process in accordance with the invention is based on the fact that the surfaces require no prior surface treatment to improve adhesion and the application of intermediate layers to increase the adhesive strength is no longer necessary. The economical and technical advantages are thus obvious. Moreover, since no intermediate layer of adhesive agent is needed the process is more reliable than before, because the known adhesive agents tended to lose their chemical effectiveness when in contact with the atmosphere for a long period and also tended to become useless during the pressing operation by partial crushing or squeezing out.

The process in accordance with the invention is also of importance for producing articles of EVM which contain metallic reinforcement layers, for example for producing bands and belts. The process is especially favourable when used for the production of conveyor belts, because in this case the other good physical properties of EVM are of particular benefit. Possibly of even greater importance is the use of the invention for building up EVM-metal elements, which for the most varied intended uses are adapted to replace rubber-metal elements.

The following examples show the composition of mixtures which may be used in accordance with the invention.

EXAMPLE 1

100	parts ethylene/vinyl acetate copolymer (with 45% vinyl acetate)
40	parts filler (e.g. SRF carbon black)
1	part fatty acid
6	parts organic peroxide (e.g. phlegmatizised dicumyl peroxide)
4	parts of triallyl phosphate
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EXAMPLE 2

100	parts ethylene/vinyl acetate copolymer (with 45% vinyl acetate)
40	parts active silicic acid
1	part of fatty acid
6	parts of organic peroxide
4	parts of triallyl phosphate
2	parts of resin
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WHAT WE CLAIM IS:—

1. A process for bonding cross-linked copolymers of ethylene and vinyl acetate, or mixtures containing such copolymers, to the surface of metals or of polymeric materials, which process comprises cross-linking a copolymer of ethylene and vinyl acetate using a peroxide cross-linking agent in the presence of a low-molecular organic phosphate having a plurality of olefinic double bonds, and bonding the cross-linked copolymer to the surface by heating.

2. A process as claimed in claim 1, in which the cross-linking and the bonding are carried out simultaneously at a temperature in the range of 100° to 160°C.

3. A process as claimed in claim 1 or claim 2, in which the organic phosphate is triallyl phosphate.

4. A process for bonding cross-linked copolymers of ethylene and vinyl acetate to the surfaces of metals or of polymeric materials, comprising applying to the surface a composition substantially as described in either of the examples and heating.

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Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press (Leamington) Ltd.—1963. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.